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Cross-section of Equity Returns Motivated by Fama and French

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Abstract

The market β has been at the core of finance texts for decades. Fama and French (1992) find startling results that decry the importance of the β as a major explanatory variable for stock returns. We continue in that fashion, and attempt to discover other variables that may have an importance in explaining stock returns. We also run the Fama-French size and book-to-market ratios tests on our dataset in order to have a point of comparison for our model.

Cross-section; equity returns, stock returns

1. Introduction

We derive our motivation for this work based on the work of Eugene F. Fama and Kenneth R. French (1992) where they debunk the importance of the market β which has been at the core of finance syllabuses for the past few decades. They spark off a great search for variables that can better explain stock returns than that of the single variable, the market β introduced in the Sharpe (1964), Lintner (1965), and Black (1972) asset-pricing model. Fama and French (1992) find size and book-to-market equity as the main explanatory factors that explain the cross-sectional variation in average stock returns.

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Here, our objective is to improve upon their work in two ways. First, we use current information about stocks to predict the future performance of stocks, using an ex-ante approach. And secondly, we use a slightly sophisticated statistical technique for this task – factor analysis to combine a large number of variables into several manageable factors in order to predict the future performance of stocks.

Our work shows a marked improvement in the R square which falls within the range of 20-30% which is quite good from the social sciences' point of view. This R square is noticeably higher compared to when we use the variables suggested by Fama and French (1992) of size and book-to-market equity on the same dataset. We are applying our tests on the Malaysian equity market from the year 2000 to 2009.

2. Data and Methodology

2.1. Data

We use annual stock returns information from the year 2000 to 2009. We start off with 70 observed variables, mostly accounting information and ratios e.g. long-term debt, total debt, liquidity, current assets, current liabilities, etc. Our final model incorporates 39 observed variables, some of them being trimmed due to repetition, being too similar to each other, and so as not to make the model too lengthy.

2.2. Methodology

The initial step is to perform data cleaning in order to produce a useable dataset.

Then, we factor analyse these 39 observed variables into their components using the SPSS statistical software. We use the principal components extraction method with varimax rotation method. We allow the variables to naturally load based on their eigenvalue without fixing the number of factors beforehand. Before factor analyzing the 39 observed variables, we first separate them into two groups, one composed of the small-value observation, which we call 'ratio' variables as most of these variables are in fact accounting ratios, and the other group consisting of large-value observations mostly in terms of millions of ringgit, termed as 'absolute' variables.

We obtain seven factors from the ratio variables, and three factors from the absolute variables, the factor loading tables are included in the Appendix below.

Thereafter, we run an ordinary least squares regression using the factor scores as the explanatory variables. Our original dependent variable is stock returns which is calculated using the simple equation:

$$(P_1-P_0)/P_0 \quad (1)$$

Where P_1 is the current stock price and P_0 is last year's stock price. However, during the study, we find that this dependent variable produces a very low, nearly negligible R square when we run our regression. This does not match with a priori knowledge that stock prices definitely have some kind of relationship with the accounting information. Therefore, for the purpose of this study, we change our proxy used to measure the stock performance to one which measures something close to it, a measure of company performance

commonly used by investors in making investment decisions – the returns-on-equity (ROE). The following discussion and findings are all based on the use of returns-on-equity as our dependent variable.

3. A Point of Comparison

In order to have a point of comparison for our model, we apply two variables of size (as market capital here) and book-to-market-equity, as an application of the findings from the Fama-French study (1992). We apply these two variables at the categorical level, using six discrete categories to represent companies of varying sizes ranging from small to large market capital, and the four categories for the book-to-market-equity ratio, ranging from low to high.

We run this using a univariate analysis of variance (UNIANOVA) test and obtain an R square of 22.4%, adjusted R square 12.7%. We include the interaction effect between size and book-to-market-equity. This model produces a surprisingly high R square considering we are using the Fama-French variables in a different country, i.e. the Malaysian stock market, whereas their study was on the U.S. stock market, albeit both being on a similar setting, that is both are stock markets. Also, the fact that we are using size and book-to-market as categorical variables reduces the information content of the variables, which should result in a lower R square.

4. Our model

Using the factors obtained from our factor analysis, our best model incorporates four factors and the standard deviation of returns-on-equity. This model obtains an R square of 39.6%, and adjusted R square of 38.0%. We consider this a significant first triumph, an indication that we are at least heading in the right direction. The equation for our best model in this paper is as follows:

$$AverageROE = constant + \beta 1 EQRETURNS + \beta 2 PROFIT + \beta 3 FUTUREPROFIT + \beta 4 LEVERAGE + \beta 5 SDROE + Error\ term \quad (2)$$

AverageROE: Average returns-on-equity; a measure of company performance that we are using as the alternative proxy to stock returns, which is a measure of stock performance. Unsubstantiated in this paper, but we hope to strengthen this in future papers.

EQRETURNS: Excess equity returns, defined as the excess of equity returns over the risk-free rate, a factor or latent variable combining observed variables that are related to the measurement of excess equity returns;

PROFIT: Current year profitability, a factor variable combining observed variables that measure profitability;

FUTUREPROFIT: Predicted profitability, a factor variable combining observed variables that proxy for an analysts' predictions of future profit. Due to limitation of data, we use the actual profit earned in future years, rather than predicted profit as it should ideally be;

LEVERAGE: A factor variable combining various measures of a firm's debt level;

SDROE: Standard deviation of returns-on-equity.

We include the t-statistics and p-values of our best model below.

Table 1: Regression results of best model
Included observations: 197

Variable	*Coeff.*	*Std. Error*	*t-Statistic*	*Prob.*
EQRETURNS	*2.65*	*1.08*	*2.447*	*0.015*
PROFIT	*8.24*	*1.04*	*7.962*	*0.000*
FUTUREPROFIT	*2.60*	*1.04*	*2.498*	*0.013*
LEVERAGE	*2.91*	*1.07*	*2.722*	*0.007*
SDROE	*-0.22*	*0.04*	*-5.940*	*0.000*
constant	*7.91*	*1.20*	*6.597*	*0.000*

5. Discussion

We note that all four factors (EQRETURNS, PROFIT, FUTUREPROFIT, and LEVERAGE) have a positive effect on the AverageROE. So far this makes sense according to a priori knowledge. When there is an excess in equity premium over government securities (the proxy for risk-free rate), then returns-on-equity go up. When there is an increase in profitability measures, the returns-on-equity goes up.

As for future profitability, an increase here may also indicate an increase in growth opportunities, causing the returns-on-equity to go up. Lastly, an increase in debt measures, returns-on-equity go up, consistent with the usage of leverage, as long as borrowing is not excessive.

As for the standard deviation on ROE, which measures the variation of ROE, where variation is a common measure for risk, the results show a small negative effect on returns-on-equity. In other words, a drop in the variability of ROE produces a slight increase in returns, up to one-fifth of the magnitude of the drop in variation (risk). This again makes sense according to common reasoning.

We find slightly puzzling the fact that the absolute variables are less significant to our model than the ratio variables. It is noticeable in Eq. 2 that the four factors taken in the final model are ratio variables. We run a further test just on the absolute variables alone regressed on the same dependent variable to investigate the matter. The model which uses only absolute variables obtains an R square of 22%. However, inclusion of any one of these absolute variables together with the four ratio variables has nearly no effect on R square at all.

6. Conclusion

Overall, we find this direction of research quite promising due to the marked improvement in R square and adjusted R square of our final model over the comparison model using size and book-to-market ratio.

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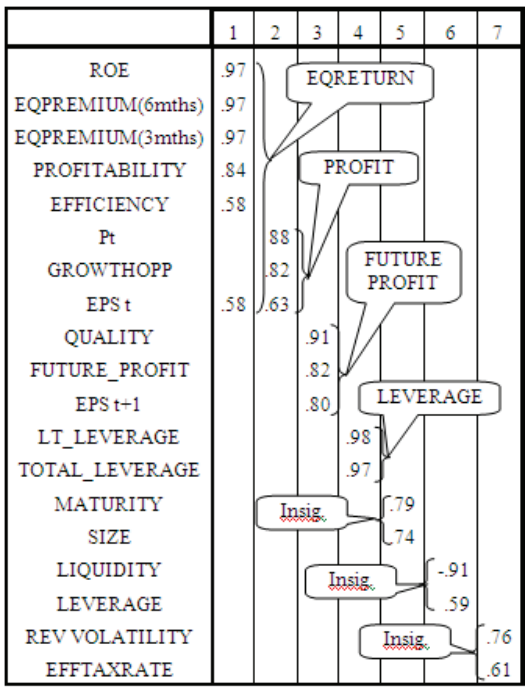
Appendix A. Factor Loading Table for 'Ratio' Variables



Rotated Component Matrix
Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations. (Natural loading of factors)

Explanatory Notes on 'Ratio' Variables:

ROE: Returns on equity
EQPREMIUM (6 mths): Equity premium, computed as the difference between returns on equity over the 6 month T-bill rate.
EQPREMIUM (3mths): Equity premium, computed as the difference between returns on equity over the 3 month T-bill rate.
PROFITABILITY: Earnings before interest, tax, and depreciation allowance divided by total assets.
EFFICIENCY: A measure of the efficiency of the management of the company, computed as total assets divided by current assets.

Pt: Current year annual stock price.
GROWTHOPP: Growth opportunity, a measure of the company's potential for growth, computed as the sum of total assets - shareholders' equity + market capitalization, the sum thereof is divided by total assets. The resulting effect is similar to a market to book ratio.
EPSt: Current year earnings per share.
QUALITY: This is a ratio of projected earnings to market price.
FUTURE_PROFIT: Computed as premium of next year's earnings per share over current year's earnings per share divided by earnings per share.
EPS t+1: Next year's earnings per share.
LT_LEVERAGE: Long term leverage, computed as long-term debt divided by shareholders' equity.
TOTAL_LEVERAGE: Total leverage, computed as total debt divided by shareholders' equity.
MATURITY: A measure of the maturity of the debt portfolio held by the company, computed as long-term debt divided by total debt.
SIZE: Size computed by the natural log of total assets.
LIQUIDITY: Computed by current assets divided by current liabilities.
LEVERAGE: Computed by total debt divided by total assets.
REV VOLATILITY: Revenue volatility, computed as the absolute value of, growth in revenue minus the average growth in earnings per share.
EFFTAXRATE: The effective tax rate, computed as income tax divided pre-tax income.

Appendix B. Factor Loading Table of 'Absolute' Variables

	1	2	3
TOTALDEBT(A)	.92		
LTDEBT(A)	.92		
FIXEDASSETS(A)	.88		
NETPPE(A)	.88		
GROSSPPE(A)	.88		
TOTALASSETS(A)	.86		
STDEBT(A)	.82		
DEPRECIATION(A)	.77		
REVENUE(A)	.74		.46
EBITDA t(A)	.71	.64	
COMMONEQ(A)	.68	.55	
EBITDA t-1(A)	.65	.55	
INCBEFORETAX(A)		.90	
NET_INCOME (A)		.89	
EBIT t(A)	.59	.74	
OPINCOME(A)	.52	.68	
MARKETCAP(A)	.67	.67	
TANGIBLEASSETS(A)			.79
TAX(A)		.49	.75
CASSETS(A)	.46		.67
EBIT t-1(A)		.55	.56

SIZE

Insig.

Insig.

Rotated Component Matrix
Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 6 iterations. (Natural loading of factors)

Explanatory Notes on 'Absolute' Variables

TotalDebt: Total debt, includes all liabilities.
LT_Debt: Long term debt, includes only the long-term liabilities.
FixedAssets: Fixed assets, referring to assets of a long-term nature.
NetPPE: Net property, plant and equipment. Gross property, plant and equipment minus the accumulated depreciation.
GrossPPE: Gross property, plant and equipment. The historical book value of property, plant and equipment without any depreciation.
TotalAssets: Total assets, sum of all the assets in the balance sheet.
ST_Debt: Short term debt, referring to short-term liabilities.
DEPRECIATION: Depreciation, an expense in the income statement, referring to depreciation charged for the year.
DEPRECIATION ALLOWANCE: Depreciation allowance, referring to the
Revenue: Revenue, referring to the gross sales in the income statement.

EBITDA t: Current year earnings before interest, tax and depreciation, computed by taking the net profit then adding back the interest expense, taxes for the year, and depreciation charge for the year.
Common Equity: Referring to common shareholders' equity, usually computed as the sum of paid-up share capital plus retained earnings.
EBITDA t-1: Previous year's earnings before interest, tax and depreciation, computed by taking the net profit then adding back the interest expense, taxes for the year, and depreciation charge for the year.
INCOME BEFORE TAX: Income before tax, computed as net profit adding back the taxes.
NET_INCOME: Net income.
EBIT t: Current year's earnings before interest and tax, computed by taking the net profit then adding back the interest expense and taxes for the year.
OPERATING INCOME: Operating income, usually computed as revenue less the operating expenses.
Market Cap: Market capitalization, usually computed as number of shares issued times the market price of one share.
TangibleAssets: Tangible assets, referring to those assets which are tangible like buildings, plants, and equipment.
INCOME TAX: Income taxes for the year.
CurrentAssets: Current assets.
EBIT t-1: Previous year's earnings before interest and tax, computed by taking the net profit then adding back the interest expense and taxes for the year.